

# Why Are Knowledge Graphs Hot Right Now?



August 2024  
Amy Hodler  
Founder and Executive Dir., GraphGeeks



# Amy E. Hodler

## 10+ Yrs in Graphs

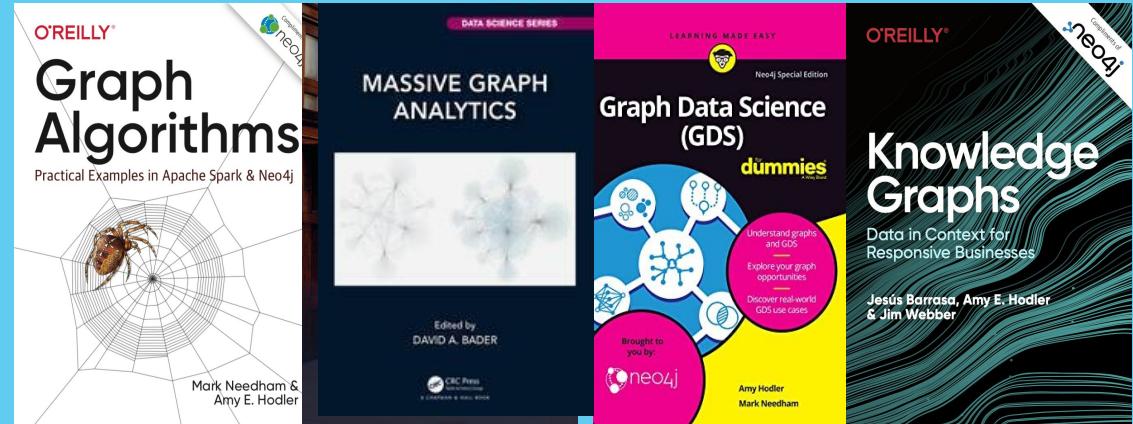


Author, Speaker, Graph & Network Science Enthusiast

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GraphGeeks

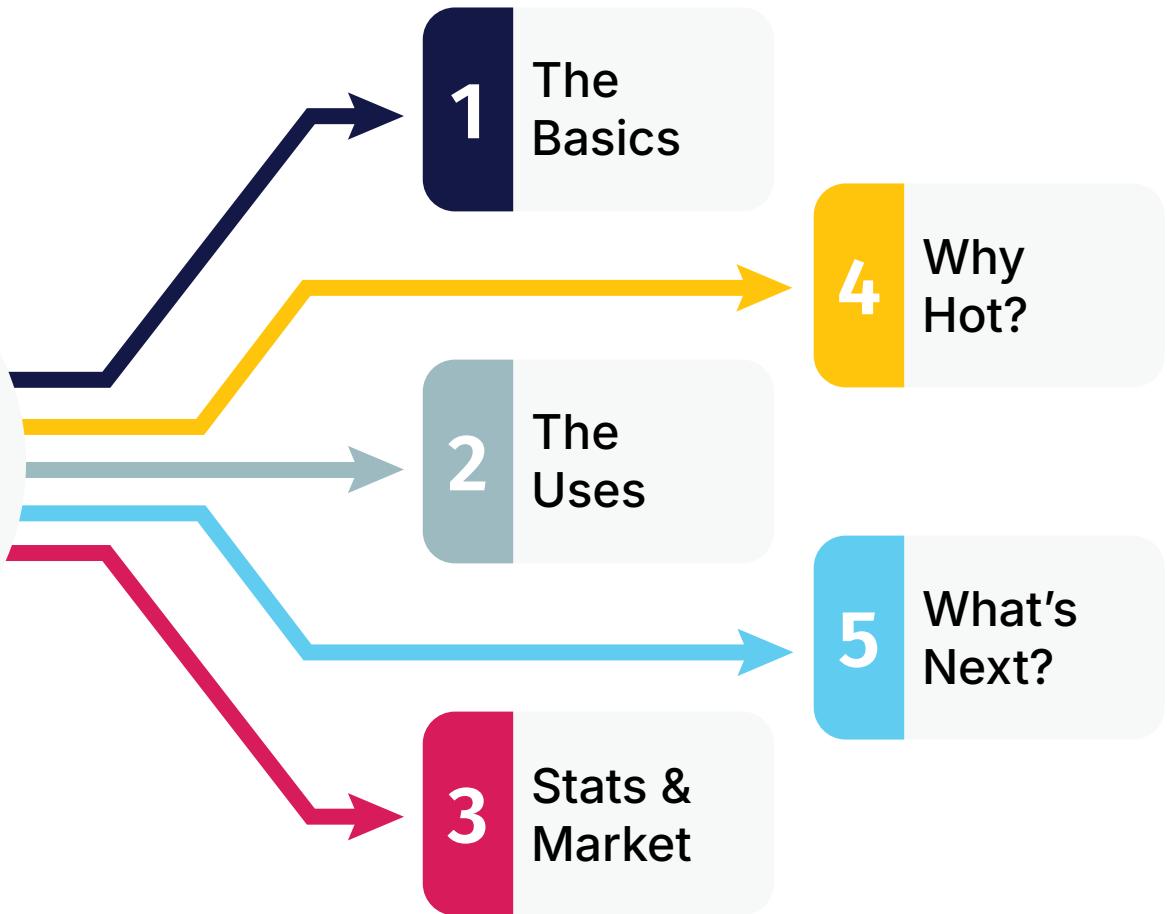


Hitachi Vantara - IoT  
Cray - Graph Engine / Urika-GX  
Neo4j - Graph Data Science  
RelationalAI - Graph Analytics  
GraphGeeks - Founder  
Various Graph Startups - Advisor

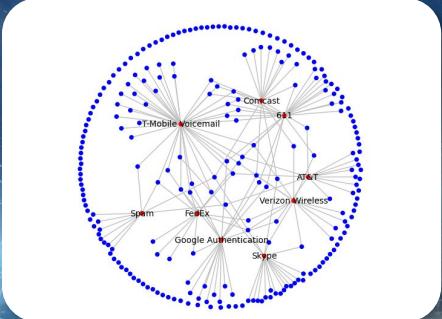




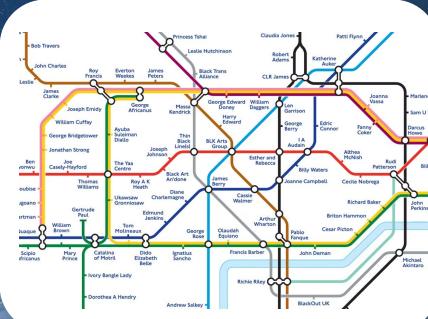
# Knowledge Graphs



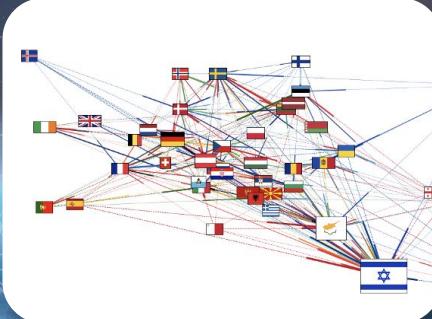
# Knowledge Graphs Make Use of Connections and Uncover Patterns



Communications



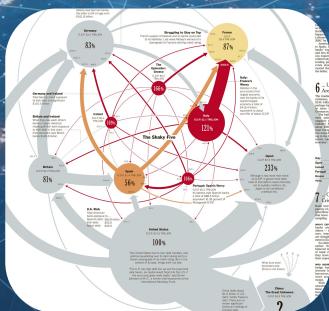
Transportation



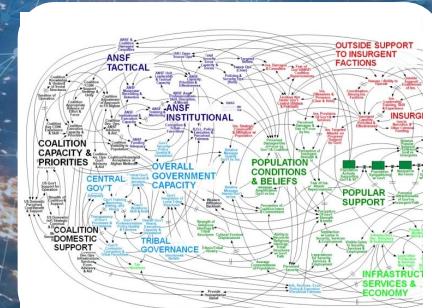
Social



Supply Chain



Finance & Banking



Security Ops

# Graph - Any Model of Nodes and Relationships

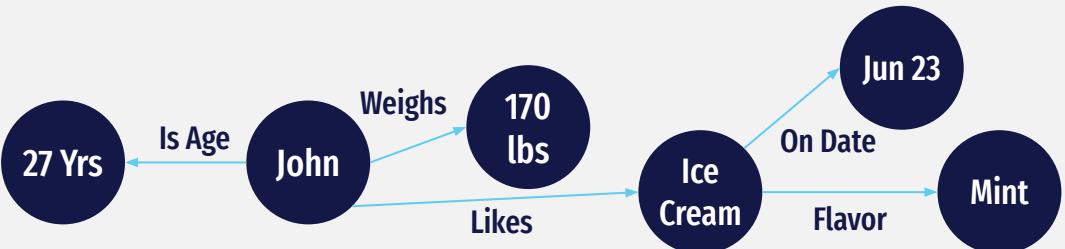
## Property Graphs

Have internal structure that can include many properties and is conducive to abstraction



## RDF Graphs

Are semantically literal which is good for inference but can be verbose



**RDF vs LPG Talk** with Jesús Barrasa and Dave Bechberger

<https://youtu.be/gMrxxt3n4mM?si=dFGU430E8iBsKm4q>

[www.youtube.com/@GraphGeeksOrg](http://www.youtube.com/@GraphGeeksOrg)

# Graph - Any Model of Nodes and Relationships

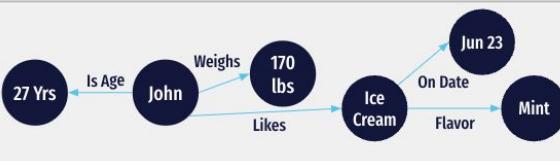
## Property Graphs

Have internal structure that can include many **properties** and is conducive to abstraction

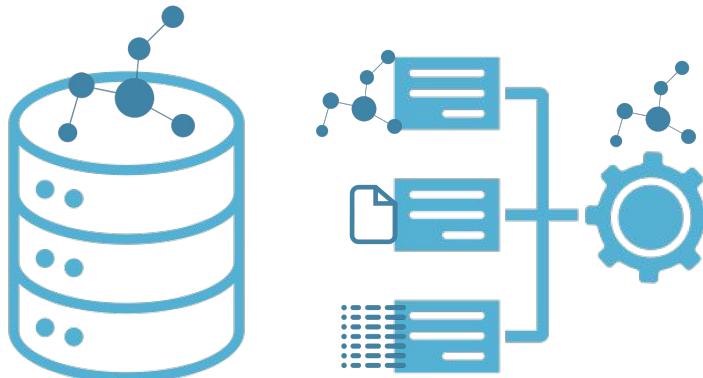


## RDF Graphs

Are semantically literal which is good for inference but can be verbose



**Graph Database**  
stores a graph  
and enables you  
to ask-answer  
questions



**Graph Processing Engine**  
Computes more complex  
graph analysis

Can be coupled with a  
graph database or  
non-graph data source

# Graph - Any Model of Nodes and Relationships

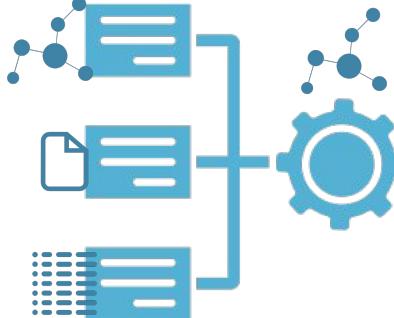
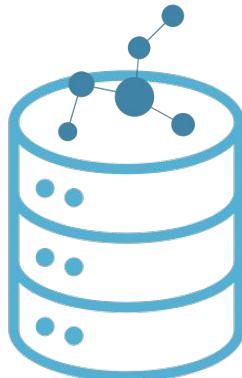
## Knowledge Graph

An instance of domain specific information and rules that exists as a graph



My company, products, customers etc  
Details on relationships & dependencies  
Definition and rules about processes

Graph Database stores a graph and enables you to ask-answer questions



Graph Processing Engine  
Computes more complex graph analysis

Can be coupled with a graph database or non-graph data source

# Traditional Knowledge Graph Uses

## Connected Data Overlay

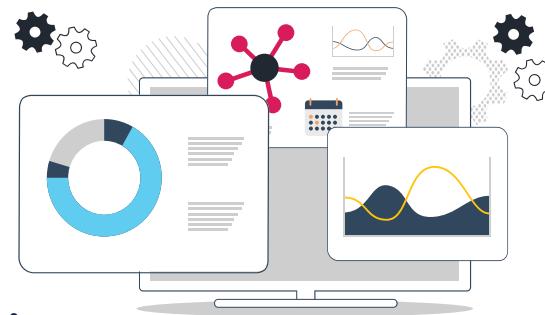
"Integrate" silos for a domain  
Data catalog/mgmt

## Better Search

Semantics  
Contextual relevance  
Inference/logic

## Human-Friendly Exploration

Serendipitous discovery  
Iterative exploration



## Decision Making

Holistic visibility  
Planning & optimization

## Better Predictions

Feature engineering  
KG completion

## Advanced Investigation

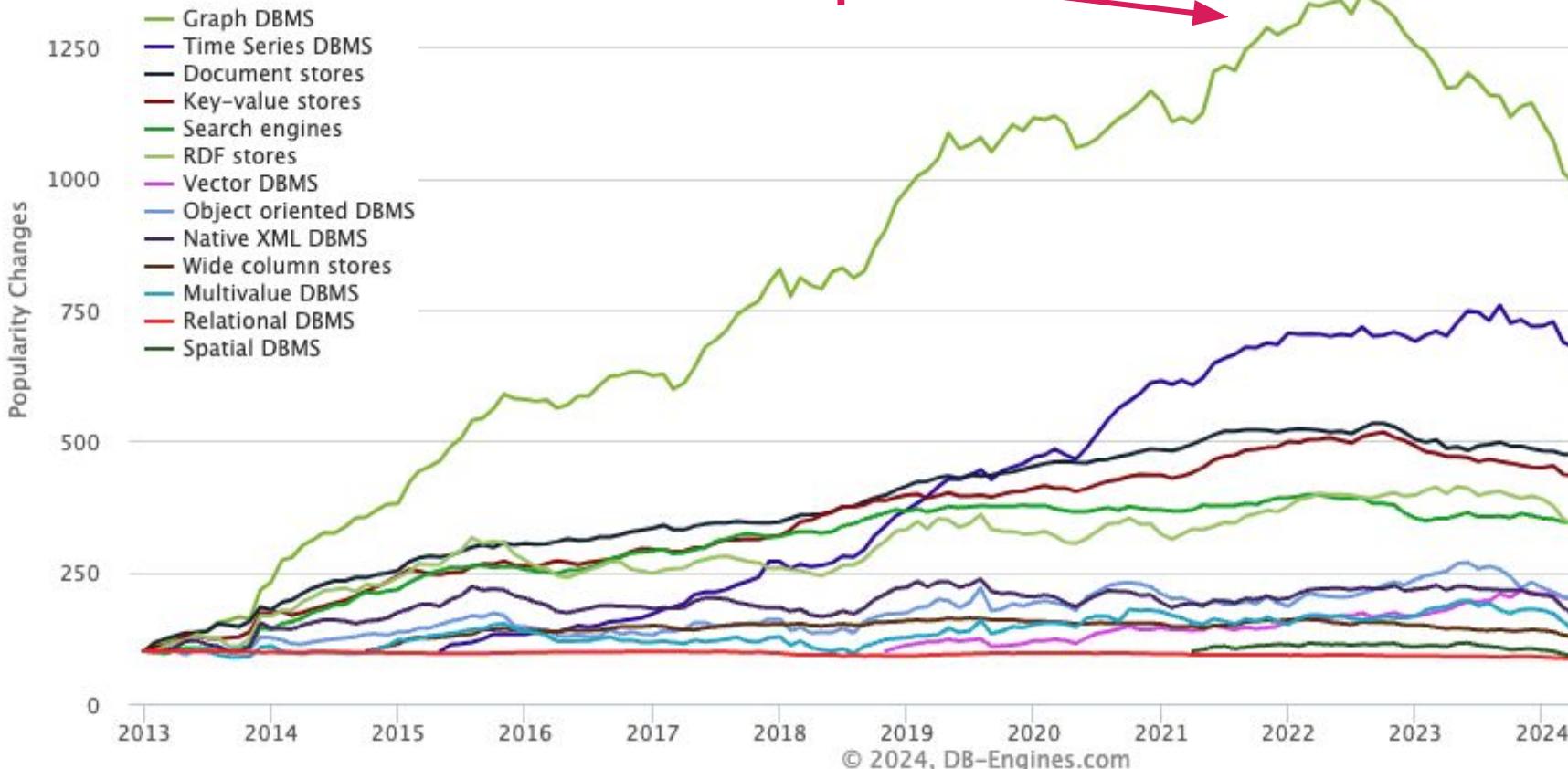
Integrated algorithms  
Interactive exploration



# Metrics and Markets



## Graph DBMS



# Knowledge Graph Search Trends Since 2004

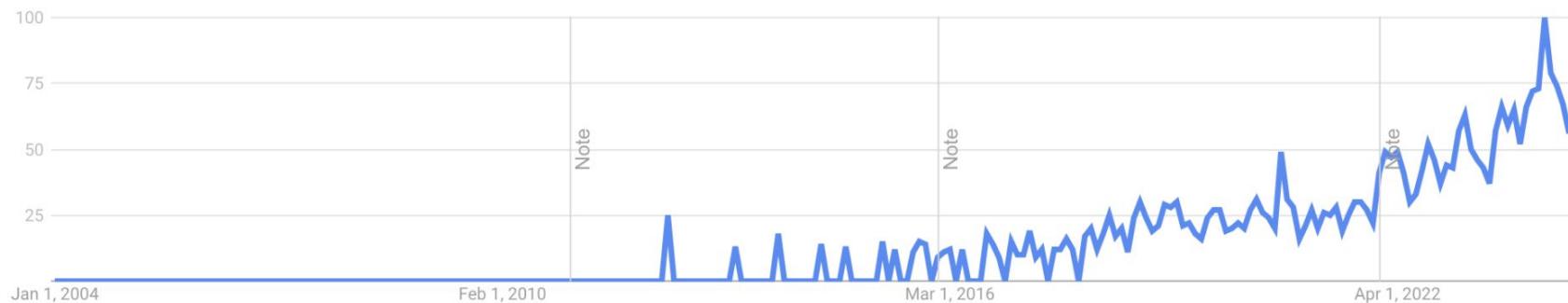
United States ▾

2004 - present ▾

All categories ▾

Web Search ▾

Interest over time ?



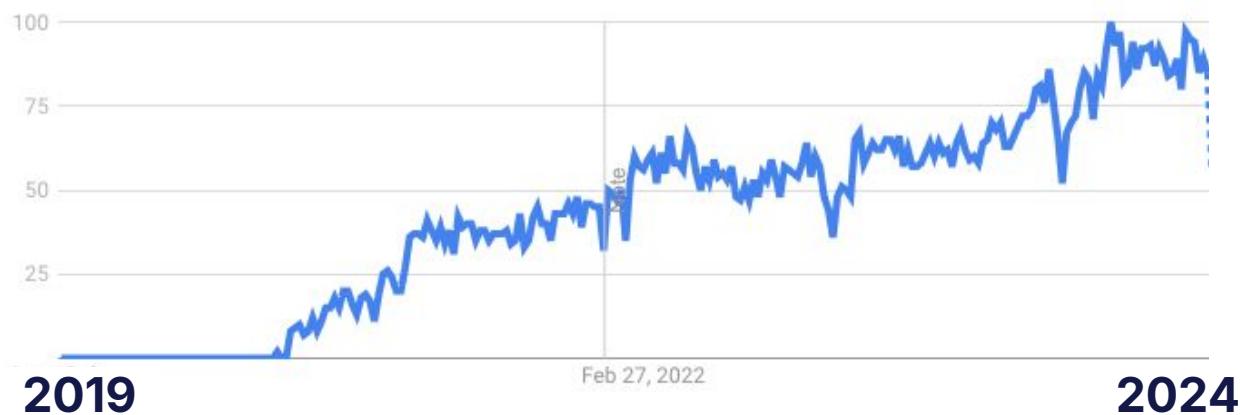
# Knowledge Graph Search Trends - Last 5 Yrs

World Wide

Interest over time [?](#)



Related queries [?](#)



1 llm knowledge graph

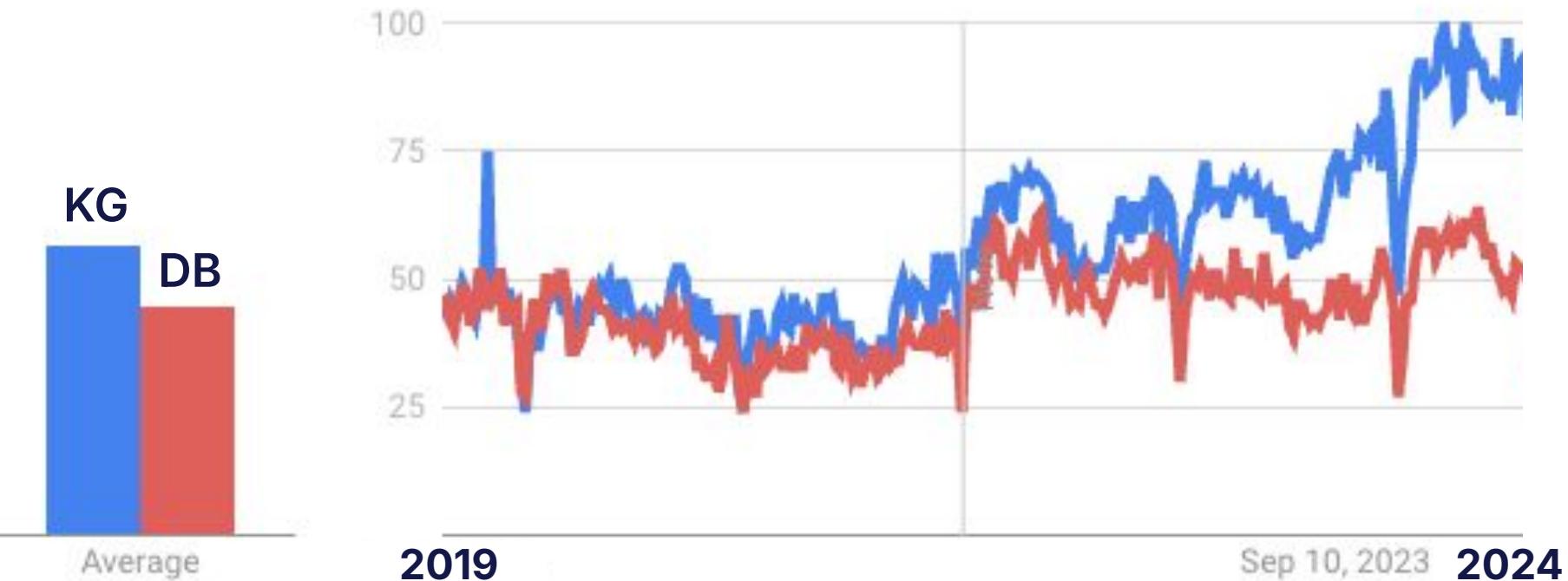
2 rag

3 chatgpt knowledge graph

4 langchain knowledge graph

5 gnn

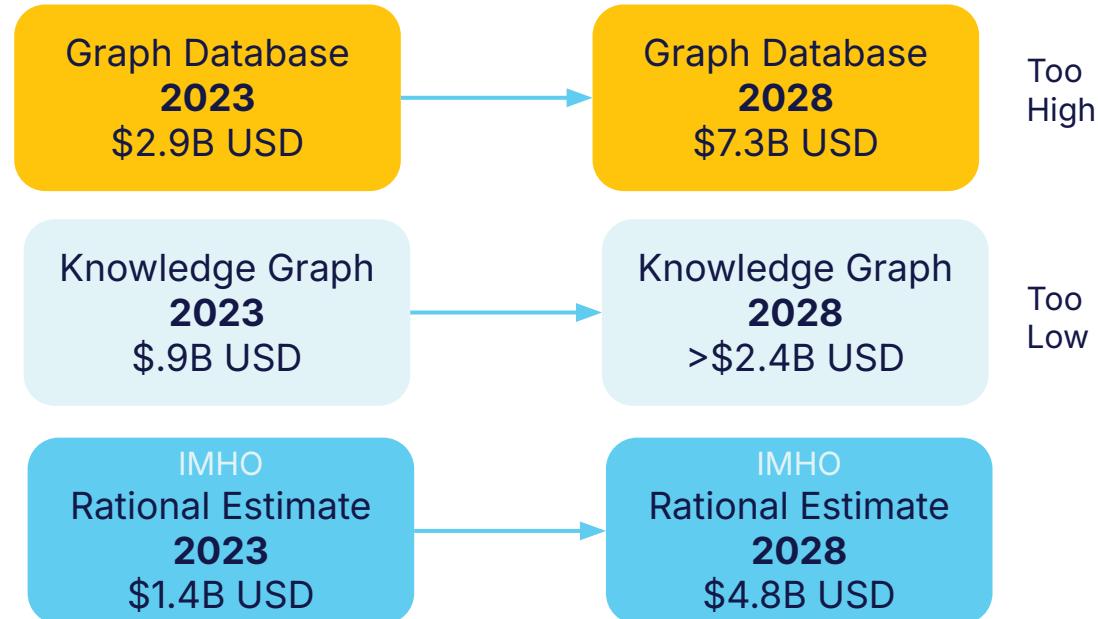
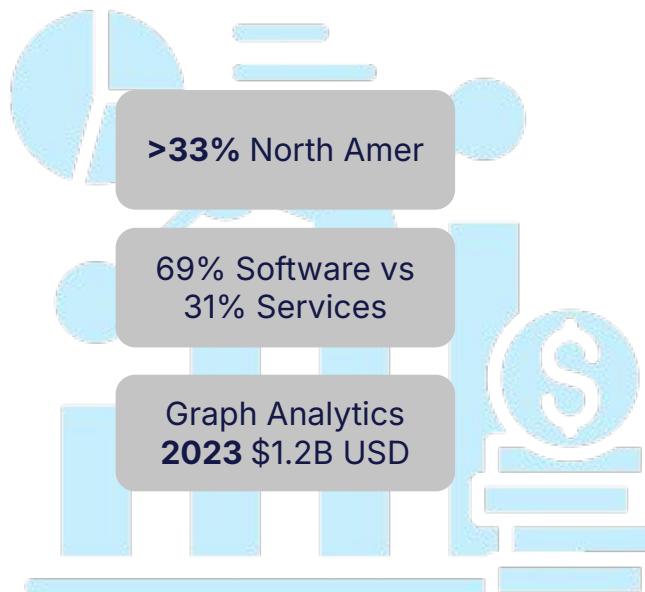
# Knowledge Graph vs Graph Database (5Yrs)



# Graphy Startups and Investments Surge

Coming Soon!

# Market Size? Depends on Definitions



<https://www.marketsandmarkets.com/Market-Reports/graph-database-market-126230231.html>

<https://www.marketsandmarkets.com/Market-Reports/knowledge-graph-market-217920811.html>

<https://www.databridgemarketresearch.com/reports/global-graph-analytics-market>

<https://www.imarcgroup.com/graph-database-market>

# What's Driving Interest?



# GenAI - Promise, Disaffection, and Promise

- Skepticism is the norm
  - Considerable effort /costs
- Eye-candy announcements and demos
- Shortcomings better understood
  - Fueling interest in Knowledge Graphs (deterministic & more mature)

≡ WIRED

SECURITY POLITICS GEAR MORE ▾

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DARON ACEMOGLU

IDEAS JAN 18, 2024 7:00 AM

## Get Ready for the Great AI Disappointment

Rose-tinted predictions for artificial intelligence's grand achievements will be swept aside by underwhelming performance and dangerous results.

## BUSINESS INSIDER

TECH Jun 29, 2024, 9:58 AM PDT

Goldman Sachs says the return on investment for AI might be disappointing

AI Aug 17, 2024, 6:08 AM PDT

This is what Goldman Sachs CEO David Solomon thinks about the AI 'bubble'

The top boss at Goldman Sachs doesn't mince



FIERCE  
Network

Broadband Cloud AI Wireless

AI

in

x

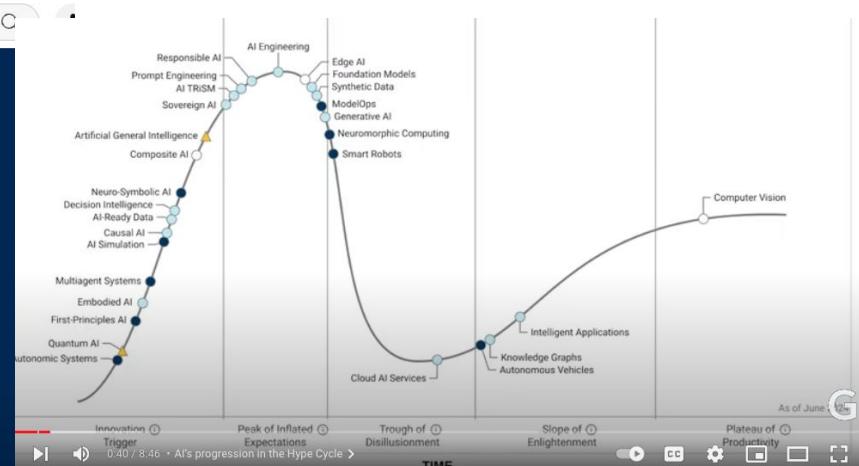
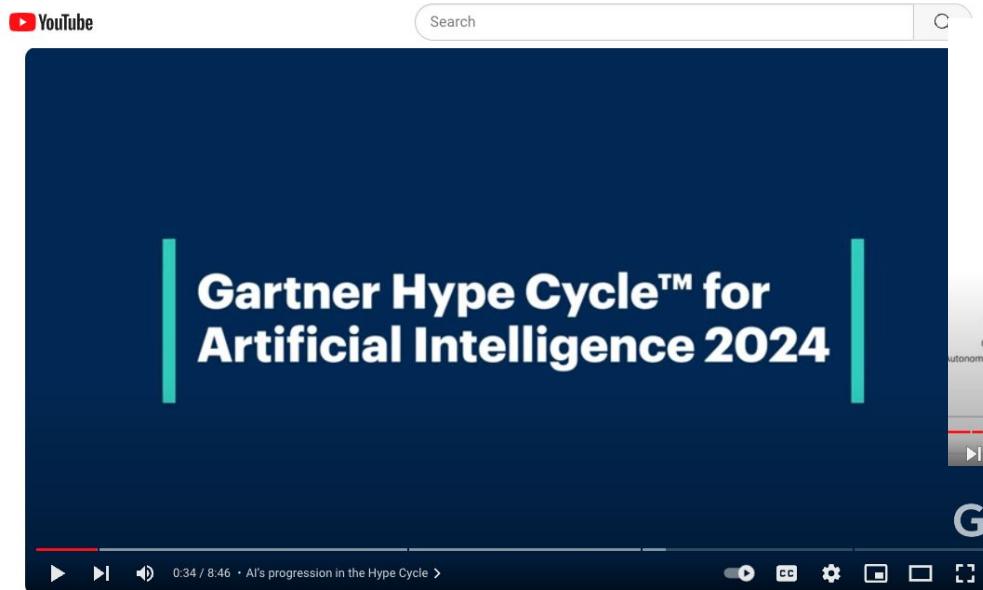
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+

GenAI sinks into the  
'trough of  
disillusionment'

# KG Matures in Comparison to GenAI

GenAI is sliding into the trough of disillusionment while Knowledge Graphs have made it out and are in the slope of enlightenment!



Gartner clients, see the full 2024 AI Hype Cycle:  
<https://gtnr.it/4cVAup1>

<https://www.youtube.com/watch?v=qXKYOR3KqxQ>

GraphGeeks

# RAG (Retrieval-Augmented Generation)

340 papers on RAG in from Jan-Jun 2024!!

- Better performance and accuracy of LLMs
- Less hallucinations
- More contextual understanding
- Adaptability and customization to specific domains and proprietary data
- Multimodal capabilities

## Check Out

- Smart search app on Epsilla for searching RAG papers  
<https://lnkd.in/q2vuJCQh>
- Ben Lorica and Prashanth Rao Recommendations  
<https://gradientflow.substack.com/p/graphrag-design-patterns-challenges>

v.2405.16506v1 [cs.LG] 26 May 2024

## GRAG: Graph Retrieval-Augmented Generation

Yuntong Hu, Zhihan Lei, Zheng Zhang, Bo Pan, Chen Ling, Liang Zhao  
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Emory University  
Atlanta, GA 30322, USA  
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### Abstract

While Retrieval-Augmented Generation (RAG) enhances the accuracy and relevance of responses by generating language models, it falls short in graph-based contexts where both textual and topological information are important. Naïve RAG approaches inherently neglect the structural intricacies of textual graphs, resulting in a critical gap in the generation process. To address this challenge, we introduce Graph Retrieval-Augmented Generation (GRAG), which significantly enhances both the retrieval and generation processes by emphasizing the importance of

## GraphRAG: Design Patterns, Challenges, Recommendations

BEN LORICA 罗瑞卡  
MAY 30, 2024

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### 1. Introduction



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## Enhancing RAG with Knowledge Graphs: Blueprints, Hurdles, and Guidelines

By Ben Lorica and Prashanth Rao.

GraphRAG (Graph-based Retrieval Augmented Generation) enhances the traditional Retrieval Augmented Generation (RAG) method by integrating knowledge graphs (KGs) or graph databases with large language models (LLMs). It leverages the

Microsoft Research Blog

GraphRAG: Unlocking LLM discovery on narrative pri

Published February 13, 2024

Senior Principal Data Archi  
Manager



## Standard RAG

Relies on embeddings and vector databases to find similar content

Focuses on similarity scores for individual sentences

Generally simpler to implement and faster for retrieval

Suitable for general Q&A systems and straightforward information retrieval

## Graph RAG

Uses graph structures without relying on embeddings

Fuller understanding of data & relationships between entities

More complex, requiring knowledge graph maintenance

Suited for complex scenarios involving structured knowledge and contextual understanding

# Graph RAG Improves Results but ...

LinkedIn uses Graph RAG to cut customer support resolution time by 29.6% <https://arxiv.org/pdf/2404.17723>

Sequeda & Allemang updated previous work to reduce error rates by 20% <https://arxiv.org/pdf/2405.11706>

Building a knowledge graph is a challenge  
Garbage In → Garbage Out  
Need better metrics  
Need continual care and feeding

Tomaž Bratanič and Oskar Hane: Knowledge Graph-Enhanced RAG [www.manning.com/books/knowledge-graph-enhanced-rag](http://www.manning.com/books/knowledge-graph-enhanced-rag)

11706v1 [cs.AI] 20 May 2024

## INCREASING THE LLM ACCURACY FOR QUESTION ANSWERING: ONTOLOGIES TO THE RESCUE!

### TECHNICAL REPORT

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data.world AI Lab  
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Juan F. Sequeda  
data.world AI Lab  
juan@data.world

May 21, 2024

### ABSTRACT

There is increasing evidence that question answering (QA) systems with Large Language Models (LLMs), which employ a knowledge graph-based representation of an enterprise's (i.e., Text+SPARQL), achieve higher accuracy compared to systems that answer queries by simply running a Text-to-SQL query against a database. Using a knowledge graph, the accuracy improved from 16% to 54%. The question remains: how can we further increase the accuracy? We propose a novel approach to improving QA research where the inaccurate LLM-generated SPARQL queries followed incorrect path planning approaches that consist of 1) Ontology-based Query Check (OBQC) detects errors in the generated SPARQL query by comparing it with the original query and the semantic of ontology and 2) LLM Repair: use the error explanations with an LLM (DALL-E) to repair the erroneous SPARQL query. The proposed approach increases the overall accuracy to 72% including an additional 8% of "I don't know" units. Thus, the overall error rate is 20%. These results provide further evidence that investing graphs, namely the ontology, provides higher accuracy for LLM-powered question answering.



Retrieval-Augmented Generation with Knowledge for Customer Service Question Answering

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[!] 6 May 2024

### ABSTRACT

In customer service technical support, swiftly and accurately resolving customer-related issues is critical to efficiently resolving cases.

### KEYWORDS

Large Language Model  
Retrieval-Augmented Generation  
ACM Reference Format

Zhentao Xu, Mark J. Deshpande, Xiang Wang, Tie Wang, Manasi Deshpande, and Zhenyu Li

Computation with Knowledge for Question Answering

swerving. In Proceedings

on Research and Developmen

14–18, 2024, Washington,

District of Columbia, USA

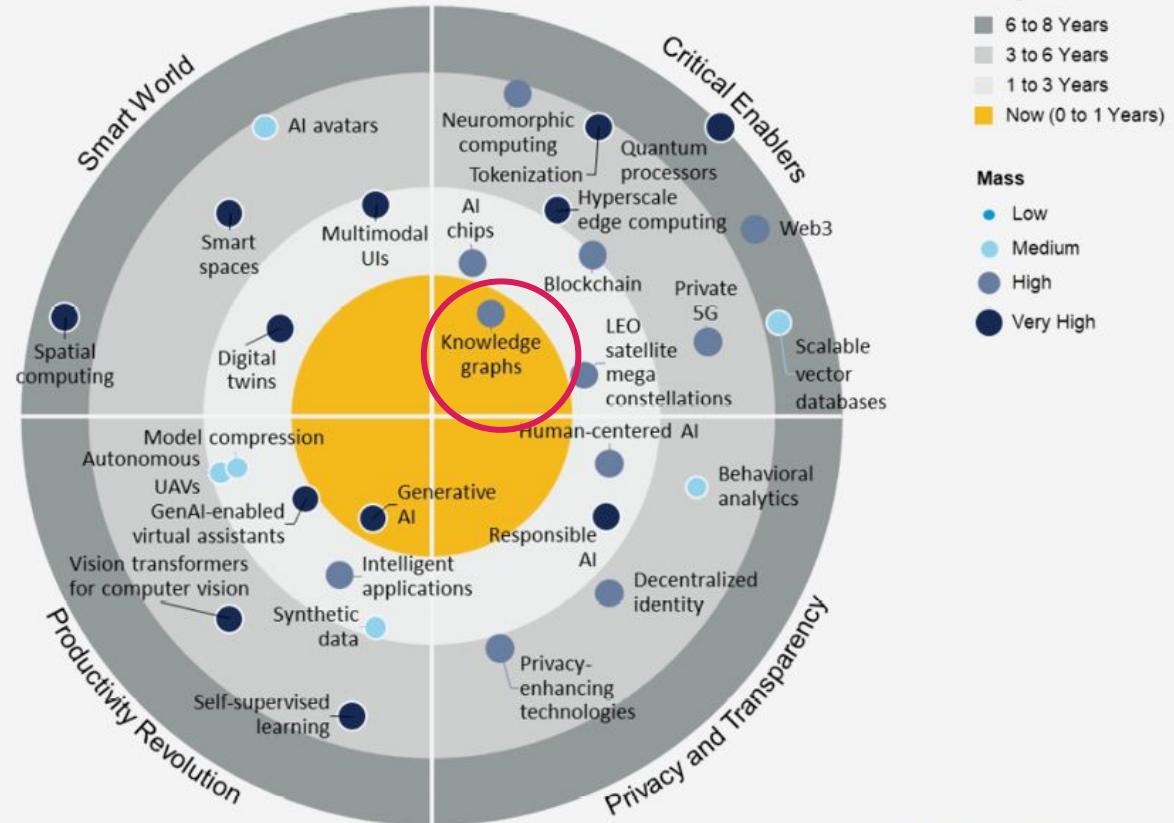
https://doi.org/10.1145/

INTRODUCTIVE technical success, directly in the frequent and Nov issues, new models for advancements in generative models (LLMs) have significantly

capabilities

Gartner recently published a list of 30 emerging technologies identified as critical for product leaders to evaluate as part of their competitive strategy

## Impact Radar for 2024



Source: Gartner  
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**Gartner**

# Semantics: Top 10 Trend in Data Integration and Engineering

Presented by Mark Beyer  
at Gartner D&A London

## Trend 6: Add Semantic Data Integration & Knowledge Graphs

Multirelationship data is complex.  
Real-world is *situational, layered and changing* — this represents context to the data (often missing).

W3C standards such as RDF, OWL, SPARQL enable your data to speak a common universal language.

Semantic integration enables efficient data understanding and ontology mapping.

Create scalable knowledge representations of data with associated meanings called “knowledge graphs.”

Populating a knowledge graph from source data:

A knowledge graph acquires and integrates data into an ontology (or many) and then makes it available to applications.

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Gartner.

## Knowledge Graphs Capture Context and Metadata in a Unified Model

Understanding the relationships between objects is necessary ...

- Traditional data modeling assumes static requirements and cannot handle relationship data without complexity.
- Performance degrades with the increasing number of relationships and joins.
- Data fabric presents multirelationship data as knowledge graphs.
- Knowledge graphs are interconnected graphs of data along with relationships and semantics.
- It allows SMEs to model and enrich data with semantics and meaning.

... Yet, most relationship insights are lost when using traditional data modeling and integration approaches.

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Gartner.



# What's Next?



# KG Challenges We (still) Have to Address

## GraphRAG Disappointment

Garbage In → Out

Unexpected effort

Productization  
and maintenance



## Lack of Expertise

Graph experience  
(different types)

Domain SME

Ontology/Schema

Dunning Kruger effect



## Quality Measures

## Graph Modeling

Needs expertise  
Many choices  
Specific to use

## Not Fluid

Lack of interoperability  
ETL/ELT needs auto  
Transforms are onerous  
Hard to blend data

## Lack of Critical Mass

Emerging standards

# Knowledge Graph Themes in 6 Months!

GraphRAG  
& Building KG  
Get Practical

AI as Enabler to  
KG

Graph BI  
Enters the Stage

- 1
- 2
- 3

**Practical Workflows:** Paco Nathan  
*Constructing KG from Unstructured Data*  
<https://www.youtube.com/@graphgeeksorg>

Improved natural interfaces  
Blending KG & analytics  
BI Like capabilities

**Hybrid RAG:** *Integrating Knowledge Graphs & Vector*  
... <https://arxiv.org/abs/2408.04948>

Knowledge Graphs reinvigorate expert systems?

# Undercurrents to Watch



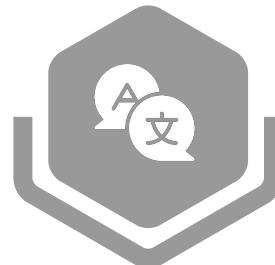
## Graph Frameworks

Databases vs engines (and?)

RDF+ LPG stacks

Big & small graphs

Unstructured and relational data

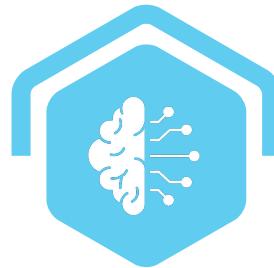


## De-Evolution of Query Languages

Driving languages lower; usability?

Mixing declarative and procedural

GQL/PGSQL but now what?



## AI & Graphs

FLIP: AI → KG

Automated quality measures

Graphs+vectors

Causal graphs & what-if analysis

GNNs + KG



## Graph BI

New abstractions

Mixing data models

Fluid data transformations

Streaming updates

Hidden and seen graphs



## Advanced Graph

HyperGraphs

Temporal

Geospatial

HDGraph

Neuromorphic

**GraphGeeks**

# Vendor-Neutral Graph Community



## GraphGeeks

[discord.gg/hXyHmvW3Vy](https://discord.gg/hXyHmvW3Vy)

[youtube.com/@GraphGeeksOrg](https://youtube.com/@GraphGeeksOrg)



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